Experiments have been made on the adsorption of organic acids from aqueous solution, and the results finally obtained, together with those on soaps, all of which have a high positive adsorption, will be reported in the complete papers which will be published in the *Journal of the American Chemical Society*. A recent paper by Hardy[4] gives valuable information on the application of the principles of surface action to the problem of lubrication. Hardy was the first worker to investigate the application of the Dupré equation to interfaces between water and organic liquids. Our complete papers will consider the relation between adhesion and lubrication. Experiments are now in progress on the heat of adsorption of liquids on solids, both on dispersiod and plane surfaces, and calculations are in progress which will relate the results given in this paper to the atomic and molecular distances.

[1] Dupre, *Theorie Mécanique de la Chaleur*, Paris, 1869, p. 69; Lord Rayleigh, Phil. Mag. (5) **30**, (1890), (461), Hardy, *Proc. Roy. Soc., London*, (A) **88**, 1913, (303–33), Harkins, Brown, and Davies, *J. Amer. Chem. Soc.*, **39**, 1917, (354–64).

[2] Antonow, *J. Chem. Phys.*, **5**, 1907, (384).

[3] F. Schmidt, *Leipzig, Ann. Physik*, **39**, 1912, (1108).

[4] Hardy, *Phil. Mag.*, May, 1919.

A BENIGN TUMOR THAT IS HEREDITARY IN DROSOPHILA

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1. A non-lethal hereditary tumor.—In a strain of flies with a lethal tumor, i.e. a tumor occurring in one-half of the males and causing their death (*J. Canc. Res.*, July, 1918; *J. Exper. Zool.*, February, 1919) another tumor has appeared as a mutation. The new tumor differs from the lethal one in that it is not sex-linked, i.e., it appears in females as well as males, and further in that it does not cause the death of the flies in which it occurs.

After several generations of inbreeding of males and females with tumors, a stock was obtained which breeds true to the tumor—the tumor appearing in all the flies.

Since the new tumor is not sex-linked its gene is not located in the X chromosome. To locate the gene in one of the other chromosomes, females with tumors were mated to star dichaete males. The gene for

star is located in the second chromosome and that for dichaete in the third chromosome. In the F_2 generation tumors reappeared as frequently among the star as among non-star flies. On the other hand none of the dichaete flies had tumors. This result indicates that one at least of the genes essential for tumor development is in the third chromosome closely linked to dichaete. To locate the gene at a definite locus in the third chromosome, flies with tumors were mated to dichaete 'hairless.' In the back crosses, no crossing over between the tumor and dichaete was obtained, while the crossing over between the tumor and hairless was the normal amount, 25%. The gene of the tumor is thus shown to be very close to that of dichaete which is at about 11.7 (table 1). The expected number of tumor bearing flies in the back cross is 50%. As seen in table 1 not more than 5% developed the tumor. This indicates

TABLE 1

DATE	WILD TYPE		HAIRLESS DICHAETE		HAIRLESS		DICHAETE		HAIRLESS		TUMOR	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
July 10, 1918	13	13	26	24	7	5	10	5	0	2	1	0
	28	25	58	54	9	7	14	9	2	3	3	0
	37	27	28	20	4	3	5	5	4	3	1	1
	17	16	19	17	3	4	9	5	2	2	0	1
	16	14	26	20	4	2	4	4	2	1	1	0
	32	38	30	26	14	16	20	18	4	5	2	0
Total	143	133	187	161	41	37	62	46	14	16	8	2

Crossing over between tumor and hairless = 10/40 = 25%.

that more than one gene is concerned with the inheritance of the tumor. Further investigations of this point are being made.

2. Position of tumor in larva.—To determine the time of appearance of the tumor and its position in the body 208 larvae were isolated and examined for tumors. Tumors were found in 180 of these (table 2). They seem to occur more often in the twelfth and thirteenth segments, occurring in the twelfth 97 times and in the thirteenth 72 times. Two tumors were observed in each of thirty-eight larvae. Twenty-seven of these cases had the tumors in different segments and eleven in the same segment. One larva had three tumors. Twenty-five larvae with tumors had in addition smaller tumors which were regarded as metastases. These when very small are often carried into the heart with the blood and there develop into narrow elongated tumors as shown in figure 1.

The tumor may develop in the early or in the late larval stages. Fully developed tumors have been found in two-day old larvae and very young tumors in four-day old larvae. Of the 208 larvae isolated, only 32 were without tumors. Tumors must have developed later in these individuals since all of the flies that emerged from them had tumors.

One hundred and seventy-six flies emerged from the 208 larvae isolated, approximately the same percentage as in the control experiment in which 200 larvae from a normal stock were isolated, of which 170 emerged as flies.

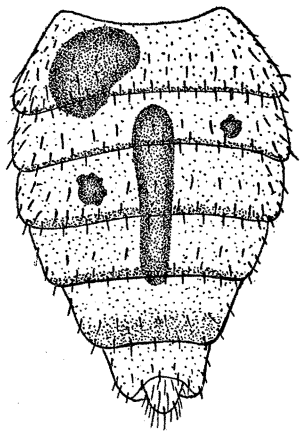
TABLE 2

POSITION OF TUMORS IN SEGMENTS	NUMBER OF LARVAE WITH TUMORS	NUMBER WITH ONE TUMOR	NUMBER WITH TWO TUMORS	NUMBER WITH THREE TUMORS	NUMBER WITH METASTASES
14	5	5			
14–13–12	1			1	
13	49	44	5		6
13–12	16		16		4
13–11	2		2		
13–10	1		1		
13–8	3		3		
12	75	65	10		12
12–11	4		4		1
12–8	1		1		1
11	8	6	2		
9	9	9			
8	5	5			
6	1	1			1
Total.....	180	135	88	3	25

Total number of larvae, 180. Total number of tumors, 226. Total number of metastases, 36.

3. Development of tumor.—The structure of the tumor in an early stage in its development in the larva is shown in figure 2. The cells are rounded or polygonal in shape and contain pigment. As the tumor grows older the amount of pigment increases, the cells filled with it become crowded towards the periphery and flattened as shown in figure 3.

The tumor takes its origin in groups of cells similar in structure to the cells found just inside of the hypodermis of the larva. These cells are originally derived from the hypodermal cells. In the fly the tumor when fully matured is entirely permeated by pigment and is black in color. The cells have stopped increasing in number. As the fly grows older the tumor tends to shrink in size but does not disappear.



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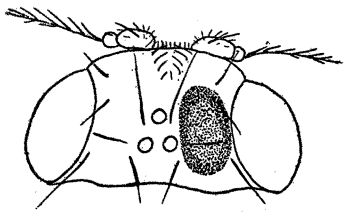

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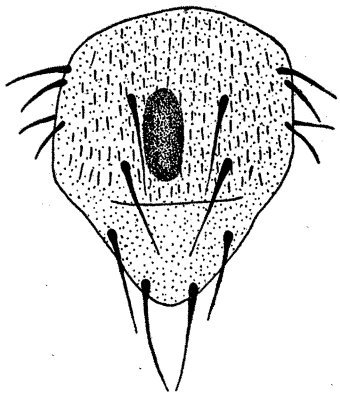

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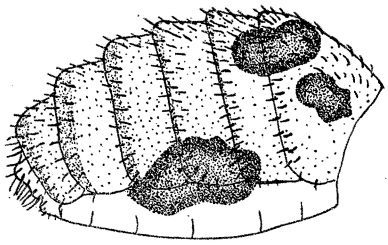

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All figures were drawn with the aid of a camera lucida, using a 16 mm. objective and ocular no. 5 with tube length of 165 mm. excepting figures 2, 3, and 5 for which the 4 mm. objective was used.

FIG. 1. Dorsal view of abdomen showing a tumor in dorsal artery.

FIG. 4. Dorsal view of head, thorax and first segment of abdomen showing a tumor in the place of the left wing.

FIG. 6. Dorsal view of head with a tumor.

FIG. 7. Dorsal view of thorax with one tumor.

FIG. 8. Side view of abdomen with three tumors.

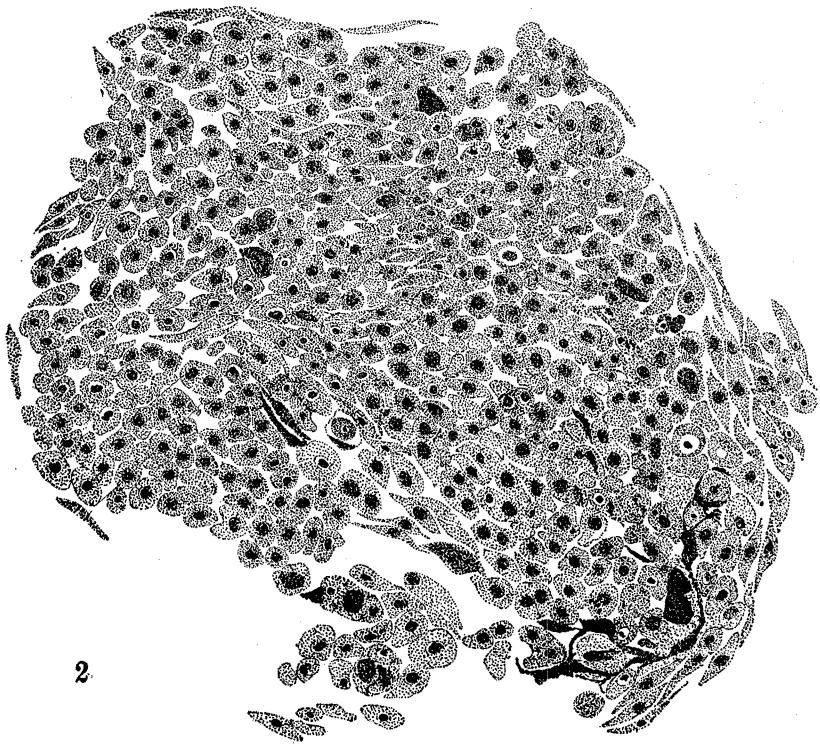

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FIG. 2. A section through the center of a tumor in an early stage of development.
FIG 3. A section through the center of a tumor in a late stage of development.

Many flies have appeared with only one wing. In place of the missing wing a large tumor has developed as shown in figure 4. The offspring from these flies do not throw a greater number of one-winged flies than do their normal sisters.

Microscopic examination of sections of the wing tumor reveals the fact that the wing disc had begun to develop but an ingrowth of the tumor cells had checked the development (figure 5).

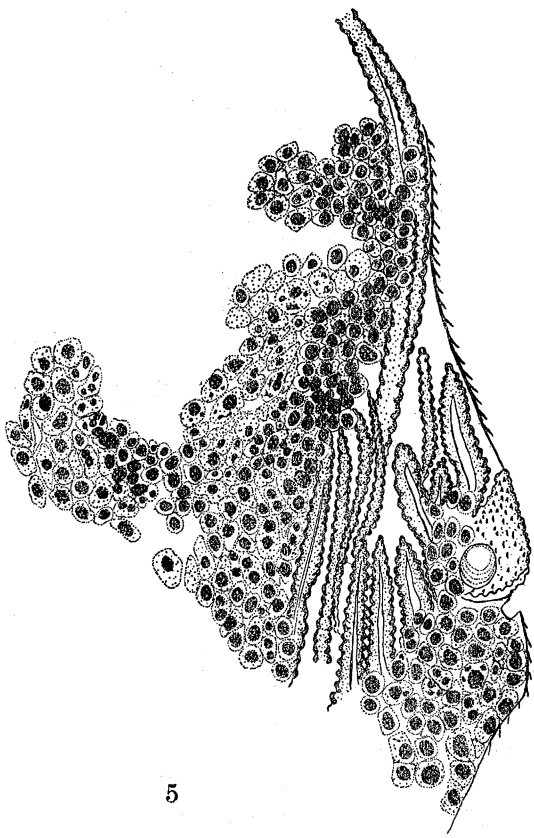

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FIG. 5. A section through the wing tumor (fig. 2) showing ingrowth of tumor cells into the partly developed wing disc.

Tumors have also appeared in place of the other appendages. In several, the fore-legs were missing, a tumor having prevented the complete development of the imaginal discs of the legs. These flies had difficulty in balancing the body and did not live long. In many flies only one leg or only a portion of the leg would be displaced by a tumor.

The tumor may appear in the head, see figure 6. Many flies with head-tumors seemed to have no power of coordination and lived only a few days, while other flies did not seem to be disturbed in any way whatever.

When the tumor developed in the abdomen or in the thorax (figs. 1, 7 and 8) and did not interfere with the development of the appendages the length of life of the fly seemed to be normal. Table 3, part 'a,' gives the length of life of the females of five pairs of flies, also the number of offspring from each pair. The length of life of the female and the number of offspring correspond closely with same of control as indicated in part 'b' of table 3.

TABLE 3

NUMBER OF PAIRS	LENGTH OF LIFE OF ♀	NUMBER OF DAUGHTERS	NUMBER OF SONS
a. Pairs of flies having tumors (February 30, 1919)			
1	18 days	296	257
2	18 days	264	271
3	19 days	198	110
4	36 days	154	139
5	16 days	154	163
b. Control pairs of normal flies			
1	20	304	264
2	35	263	232
3	22	198	207

It is evident that the presence of the tumor in the abdomen and in the thorax of the body is not sufficiently injurious to decrease seriously the length of life of the fly.

4. Inoculation of tumors.—Under aseptic conditions young tumors were removed from larvae and inserted into larvae of a different strain normally free from tumors. Forty larvae were thus inoculated. Only five percent (two) survived the operation, but these continued to live, completed metamorphosis and carried the inserted tumor into the adult fly. Both these flies were females and were sterile. Matings were attempted with several males but without success. The tumor was found to resemble exactly the tumor that occurs normally in the adult fly in the stock from which it was originally removed.

A few of the larvae from which the tumors were removed recovered from the operation. Some of these completed metamorphosis. All of the offspring from these had tumors showing that the tumor is due to something in the germ-plasm which is handed over from one generation

to another even though the parents are deprived of the tumors by an operation.

I am gratefully indebted to Professor Morgan and Doctor Bridges for helpful suggestions.

Conclusions.—1. A non-lethal tumor appeared as a mutation in the lethal tumor strain.

2. The locus of the gene of the new tumor is close to that of the dichaete in the third chromosome.

3. The tumor may occur in any segment of the larva but seems to occur more often in the twelfth and thirteenth segments.

4. The cells of the tumor are rounded or polygonal in shape and show the presence of pigment.

5. Ingrowth of tumor cells into the imaginal discs of the appendages checks the development of the parts.

6. Young tumors were inserted into larvae of normal strains. Five per cent survived the operation, completed metamorphosis and carried the inserted tumor into the adult fly.

METALLIC SALTS OF PYRROL, INDOL AND CARBAZOL

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The ammono acids, that is to say, the acids of the ammonia system of acids, bases and salts,[1] are derivatives of ammonia in which one or two hydrogen atoms of the ammonia molecule are replaced by negative groups. A number of examples of compounds so related to ammonia are nitramide or nitrosyl amide, NO_2NH_2; acetamide or acetyl amide, CH_3CONH_2; phthalimide or phthalylimide, $C_6H_4\langle{}^{CO}_{CO}\rangle NH$; benzenesulfonnitramide or nitrosyl benzenesulfonyl imide, $C_6H_5SO_2NHNO_2$; methylnitramine or methyl nitrosyl imide; acetanilide or phenyl acetyl imide; trinitraniline, $C_6H_2(NO_2)_3NH_2$; cyanamide, $CNNH_2$; urea, $CO(NH_2)_2$ etc., etc.

These substances are true acids ranging in acidity from benzenesulfonnitramide, which approaches the ordinary mineral acids in strength, through phthalimide and methyl nitramine, which are well known to possess weak acid properties, to acetamide and urea which are not